Journal of Computer and Communications, 2023, 11, 12-25
https://www.scirp.org/journal/jcc
ISSN Online: 2327-5227
ISSN Print: 2327-5219

The Application Mode of Blockchain in University Asset Management

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How to cite this paper: Tang, J.J. and Qu, W.Q. (2023) The Application Mode of Blockchain in University Asset Management. *Journal of Computer and Communications*, **11**, 12-25.
https://doi.org/10.4236/jcc.2023.111002

Received: October 22, 2022
Accepted: January 17, 2023
Published: January 20, 2023

Abstract

With the development of higher education, the scale of university assets has become more diversified, complex and decentralized. Traditional asset management is inefficient. Information is not transparent and management responsibilities are unclear. This paper analyzes the difficulties in the process of asset management in universities and discusses the advantages of blockchain technology. We research on the application of blockchain technology in the process of asset management in universities and propose a framework design based on blockchain technology to standardize the asset management process. The result improves the efficiency of asset inventory and ensures the credibility of asset information. It helps to prevent asset information tampering, and improves the security of asset data. It also pushes the asset management mode from static to dynamic.

Keywords

Blockchain, Asset Management, Higher Education

1. Introduction

The asset management of universities should adhere to the principle of "combining asset management with budget management, combining asset management with financial management, combining physical management with value management, and separating ownership and use right". By gradually establishing an asset management system with clear functions, clear rights and responsibilities, and an asset operation mechanism with scientific management and standardized operation, we should standardize the process of asset allocation, use, and disposal, and strengthen asset supervision and management, ensure the safety and integrity of assets, and realize scientific, dynamic and refined management of assets by strengthening information construction [1].

By setting up an independent asset management organization, universities are

responsible for performing their asset management responsibilities, and defining the responsibilities of asset management departments and asset use departments, as well as the management authority of asset management departments and financial departments and other asset management departments, to avoid a vacuum in management [2].

Generally speaking, as the functional department of university asset management, the Asset Management Office is responsible for the overall planning, supervision and management of university assets, and its basic functions are the definition, registration, evaluation, inventory, statistics and disposal of asset property rights. The office is also responsible for implementing laws and regulations related to government procurement. They are also in charge of organizing the application and approval of procurement management, bidding, contract negotiation, contract signing, and procurement acceptance. They also need to evaluate the using situation of assets of each department. About the management mode, the asset management of universities generally adopts the hierarchical management. The keys are unified leadership, hierarchical responsibility, centralized management, individual responsibility and making the best use of everything [3].

Through the three-level management mode of competent departments, centralized departments, and user departments, the "entrance" and "exit" of the asset management of universities are well controlled, so as to promote the rational allocation of college assets, improve the efficiency of asset use, and maintain and increase the value of assets [4].

The current asset management systems are basically data processing systems for asset management, or are based on management information systems. The former only uses computers to process transaction data and generate various reports, which is the automation of daily basic transaction processing for auxiliary work activities. The latter has general auxiliary analysis, planning and decision-making capabilities. But these systems all need a core user to manage and maintain the system data and system operation. Other participants are only responsible for providing their own production data, handling their own transactions, and not participating in data management. This brings a series of data security problems, and it is easy to cause the unreliability of business processes. The constraints on participants are only at the functional level of the system, and at the data level, they are at most the requirements of data specifications, which is difficult to ensure the authenticity of data [5].

The category and connotation of university asset management is shown in **Figure 1**.

2. Problems in Assets Management in Universities

The information asymmetry of the upstream and downstream subjects of the university asset management information chain caused by such factors as time, space and technology affects the overall efficiency of asset system management. Meanwhile there is a lack of management innovation in asset benefit management, and the top level design is unreasonable, resulting in a downward pressure

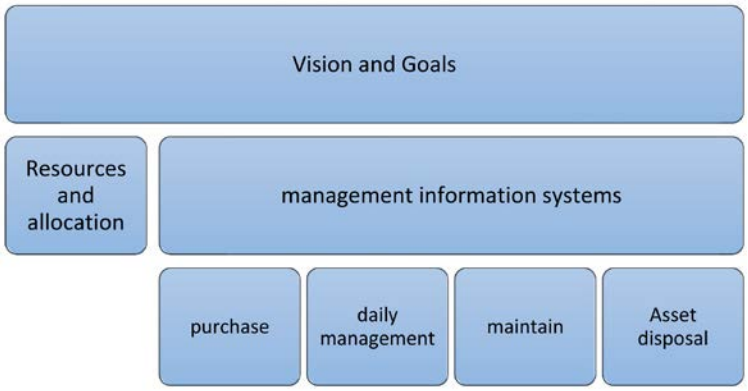

Figure 1. Category and connotation of university asset management.

on internal control risks and a sharp increase in asset management risks. Moreover, asset managers only manage the physical quantity of assets, lacking certain management thinking, and cannot broaden the asset life cycle to increase economic added value. It is mainly shown in the following aspects:

2.1. The Assets between the Balance Sheets Are Not True, Causing Some Assets to Be Separated from the Account

Due to the division of departmental functions and the asymmetry of effective information transmission, asset management in universities has insufficient smoothness and coupling in the operation of information hierarchy, which affects the accuracy of information transmission and easily leads to information islands between departments. For example, the physical assets on the books of universities mainly manage the capital assets that have been warehoused. For the physical assets outside the warehouse, such as low value consumables, the account only reflects the purchase process. For the low value consumables that have not been collected, there is no effective management, which virtually causes the assets to be dissociated from the account. The assets that have not been collected are not reflected in the tables, which is likely to cause the actual stock assets to be unreal and the management to be confused [6].

2.2. Inadequate Asset Operation Capability and Classified Management, Resulting in Asset Precipitation and Low Effectiveness

Classified according to asset operation capability and attributes: First, assets that can provide fund operation capability in time, such as cash and bank deposits; Second, assets with potential development ability and sustainable utility, such as fixed assets, projects under construction, intangible assets, etc; Third, assets with a certain transaction cycle and a short gap period, such as temporary collection and temporary payment. However, universities have not effectively matched asset attributes, and the analysis of potential capacity of assets between precipitation statements is insufficient, resulting in a large number of assets in the sleep state in the statements over the years, which is only a manifestation of digital

value and lacks vitality. In particular, the differentiation of the management system of universities has resulted in the lower vitality of asset management than that of enterprises. For example, the financial department manages the general ledger for the management of the current account of assets in colleges and universities, but the business operator completes the request for pending accounts. The failure to perform the subsequent collection obligation of the current account results in the untimely withdrawal of funds, a longer management cycle, or even a sluggish account, resulting in the loss of assets [7].

2.3. Information Asymmetry and Low Synergy

Due to the needs of discipline construction and scientific research, universities also have high requirements for instruments and equipment. At present, universities generally have insufficient synergetic effect of instruments and equipment among cross disciplines, and do not carry out overall management of instruments and equipment, resulting in low effectiveness of instruments and equipment. At the same time, some universities only examined and approved the capital budget arrangement when purchasing instruments and equipment, and did not effectively demonstrate the installation and operation site of the purchased instruments, which easily led to the failure to install and use the instruments and equipment in a timely manner after purchase. What's more, some valuable instruments have not yet started to use, the depreciation life is more than half, and asset management benefits are obviously lacking [8].

Due to its special functions, universities hold external cash flow for a certain time gap, such as deposit for contract performance and deposit for renting real estate shops. However, universities lack effective use of capital gap period for asset management, and do not reasonably analyze the aging and turnover period, resulting in this part of assets settling in the gap period.

2.4. Unsuitable Asset Management Tools

The asset management system of universities is closely combined with the budget management, the physical form and value form of assets are managed cooperatively, and the performance target management of universities is closely combined. However, due to the large number of personnel involved in the asset management model of colleges and universities, the management of responsibilities and rights of all parties is not in place and the business is not proficient, only the number of physical assets is managed, ignoring the management of asset value effects. Due to the lack of discipline integration in colleges and universities, there are many and complete laboratory instruments and equipment, but there is no horizontal and vertical collaborative management. The collaborative management of asset allocation and use is not strong, which virtually leads to idle assets and low marginal utility.

At present, asset management in universities only distinguishes the status of assets: in use, reaching the age limit, and scrapping, which reflects only a repre-

sentation of the static life cycle of assets. The analysis of asset production capacity is still blank. Fixed assets in universities are reduced to daily assets for maintaining normal operation, and asset benefit value creation is very scarce. The performance evaluation method of EVA is to guide enterprises to pay attention to value creation, and accordingly conduct asset management value-added and value maintenance performance management. However, the performance management of university assets is very lacking at present. Most of the performance goals are set only to analyze the performance of the use of project funds. There is no follow-up EVA analysis on the assets formed by project funds, and the potential economic benefit analysis is insufficient [9].

3. Methodology

3.1. A Tabular, Standardized, Procedural and Intelligent Model of Asset Management

In order to ensure the uniqueness of asset management data, unify and standardize the structure levels, solve the data fragmentation between departments, and break through the barrier of data islands, a tabular, standardized, procedural and intelligent data source storage mode should be established to accelerate the speed of data hierarchy operation, make it easier to extract effective data, and improve the efficiency of asset management; At the same time, the data needs to be stored on a unified information chain, and a unified information network system should be built to operate in a unified and closed Internet of Things space. The data should be managed by the time stamp mechanism, and the time stamp traceability management should be carried out to ensure data security and not be tampered with. For example, the current asset management in universities implements card account management, which manages the book value of assets and lacks the description of asset performance indicators. The asset using department must first obtain the asset performance related indicator data before it can determine whether it can be used in coordination. Standardized, streamlined, tabulated and intelligent asset management data can make up for the deficiencies of card account management, and do a good job of comprehensive information management of asset management in the early stage to provide more accurate data for the later use of assets and improve the efficiency of asset use [10].

3.2. A Data Sharing Platform

Effective application of blockchain technology requires a good industry finance integration sharing platform, detailed data comparison basis, and coordination between top-level design and data analysis. Especially in the Internet era, the amount of data information is exponentially increasing, data sources are diversified and non-oriented, and various information carriers are flooded, and data operation generates data flows at different levels. The uncertainty of data flow direction and the difficulty of accurately grasping the timeliness increase the dif-

ficulty of information validity screening. The asset management under the application of blockchain technology can continuously expand the root data by effectively matching these data, and verify each other in the unified data system to establish a consensus mechanism. For example, when universities purchase assets, they can share the use of assets in the asset management department through blockchain technology to effectively judge whether to purchase, how to purchase, and how to select suppliers, so as to avoid mistakes in decision-making [11].

3.3. Data Association Analysis

In the era of data flooded Internet, how to correctly judge the cross collection data between multiple data sources, eliminate interference factors, measure the correlation degree between factors according to the similarity or difference of the development trend between factors, and establish the analysis model of correlation degree and situation factors, which is an important manifestation of the management level of colleges and universities. Applying blockchain technology and combining grey system theory to analyze the association of asset management data can effectively eliminate interference data and invalid data, so that shared account book data under blockchain technology can establish a clear association relationship and increase the effectiveness and fullness of data; At the same time, the performance evaluation of decision results can verify the basic accuracy of data sources and further improve the effective circulation of data [12].

3.4. Network and Data Security Management System

Effective data circulation is an important manifestation of data value. The powerful network system can provide a powerful information network platform for the data flow between different subjects in the asset management cycle. At the same time, the asset management data under the blockchain technology can effectively carry out information flow interactive mapping and matching. The network model with visual architecture can provide a secure and stable information chain, provide a wide and large information flow carrier, ensure smooth data flow, and release the multiplier effect of data effectiveness. Data opening and sharing should be in a safe and stable network environment. A safe and stable network environment should standardize the data management system, classification and hierarchical management authority, data authorization and permission, scope of application, confidentiality terms, and standardize and unify from the system and framework level to effectively ensure the purification of the data ecological environment [13].

3.5. Professional Technical Service Guarantee

Asset management involves a wide range of people, and a little carelessness is likely to cause the loss of state-owned assets. Professional managers are the guarantee of human resources to improve the level of asset management in col-

leges and universities, especially the training of management talents. They implement the management requirements and are conducive to management coordination and communication. At the same time, the application of blockchain technology requires multi-disciplinary, multi-disciplinary, and multi technical means to collaborate, with a high degree of knowledge intersection and integration, the quality of managers to match it, and the knowledge system and professional technical ability to support the application of blockchain technology [14].

3.6. An Open and Shared Asset Management Model

The goal of asset management mode under the application of blockchain technology is to promote the formation of an asset management system that is systematic, scientific and standardized, data resource rights confirmation, open and transparent, rights and responsibilities consistent, data interactive supervision, and effective operation. This system can enhance the controllability of asset management information chain, effectively solve the power tug of asset allocation and multi head management, clarify responsibilities, coordinate assets, stimulate asset activity, and improve the economic added value of asset management. At the same time, the application of blockchain technology to asset management can effectively solve the problems of large differences in data structures, inconsistent standards, and unsmooth sharing. Data assets can be broadened from the source of data, and the value of physical assets can be managed through data analysis to promote the improvement of potential value capabilities. The stock of assets determines the asset allocation, which requires the unit to find out the source and effectively plan the assets. How to make rational use of asset utility to reduce waste is an important measure for colleges and universities to transform their functional efficiency. The asset management model based on blockchain technology can deepen the relationship between interconnected data, promote big data cloud connectivity, smooth the blood and channels of asset management cycle, accurately grasp the direction of asset benefits, coordinate the functions of all parties, and build a high-level asset management team. At the same time, we will tap the potential value production capacity of assets, enhance the competitiveness of universities, effectively promote the liberalization and facilitation of asset management, deepen the integration of industry and finance, consolidate the collaboration of information chain, data chain and blockchain, build an open asset management system, and provide high-quality and efficient data basis for decision-making. The overall framework of system functions is shown in **Figure 2**.

4. Operation Architecture and Workflow Analysis

4.1. Operation Architecture

The blockchain network part is mainly used to store the records of asset information changes in each link of the asset lifecycle business process. The blockchain

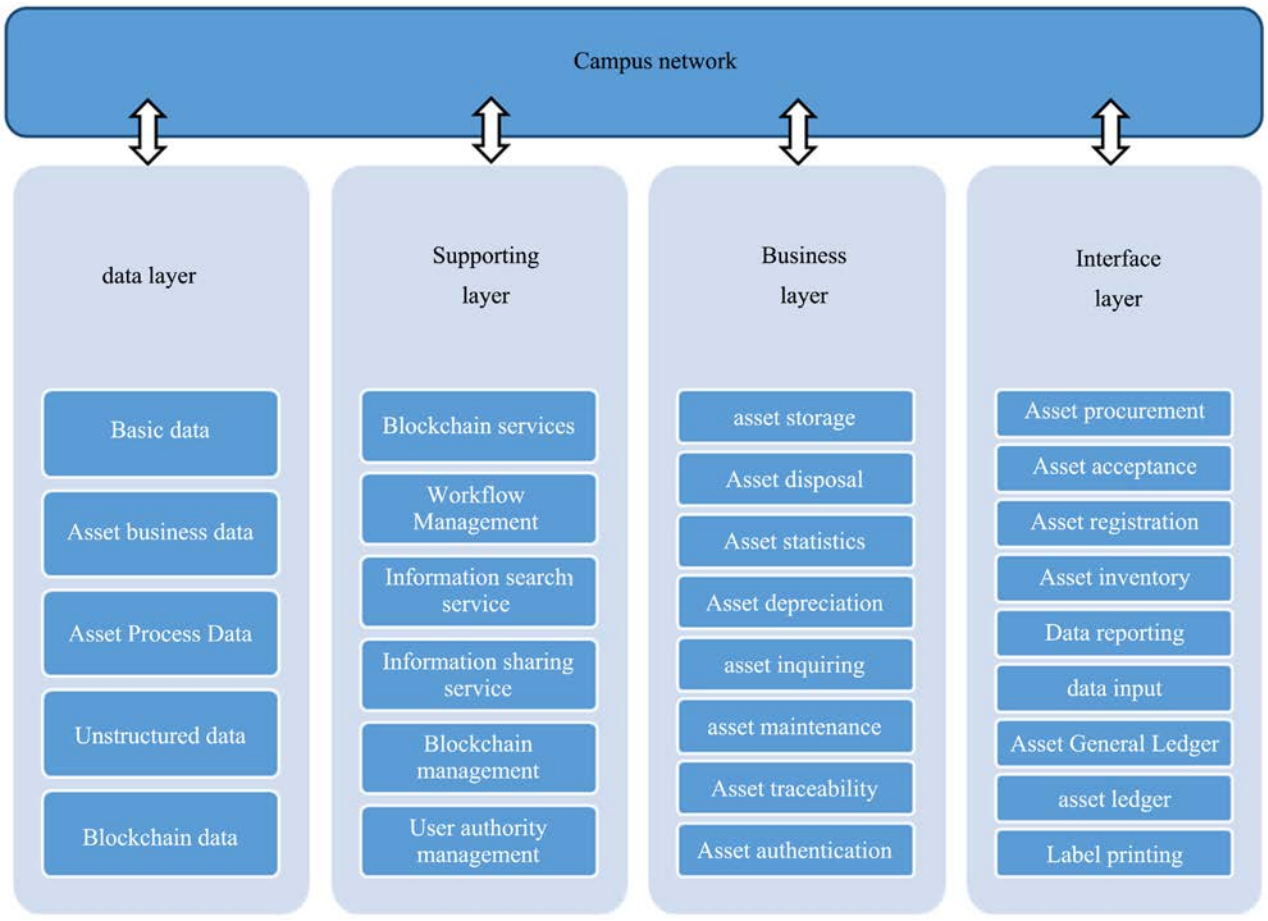

Figure 2. Overall framework of system functions.

is a chained storage structure, and the calculation of the value of each node depends on its parent node. This chained storage structure makes the storage structure of the blockchain have tamper proof characteristics, and ensures the authenticity and effectiveness of the data. The blockchain network is mainly used for digital storage and verification of grid assets.

Since there are many nodes in the blockchain network, and different departments need to store or query information on the blockchain, in order to further ensure the credibility of the system, nodes are distributed in the terminal devices of each department, which can achieve the purpose of information non repudiation. If the blockchain data of one department is tampered with maliciously, but the data of blockchain nodes of other departments can still be used normally, In addition, all node storage data are consistent, which can ensure that any single department's tampering with the blockchain data will not affect the normal use of the blockchain data. Ensure that the system has high credibility and security. In the operation framework of power grid asset life-cycle management, the asset life-cycle business flow chart has been established in the business system of the State Grid, and the new work is to build a blockchain network and deploy blockchain nodes.

4.2. Concept of Asset Identity Information Collection Equipment

In order to facilitate the collection of device identity information and the standardized management of information by various departments, this paper proposes a device that can be used to collect asset identity information. While acting as an information collection device, this device can also act as a network node in the blockchain to store the blockchain information.

Figure 3 is a working example diagram of a hardware device proposed in this paper, which specifically includes: interactive interface, camera interface, RFID acquisition device, storage and network interface, processor and blockchain interface. This device is used for information collection, information processing, information storage and other functions in the blockchain based digital asset certificate storage and verification technology. The interactive interface can be touch screen, keyboard and other interactive devices for information input, display interactive information for users and other functions. The camera interface is used to collect unstructured description data such as physical photos of assets.

RFID collection device is used to collect RFID information of physical assets. The storage and network interface is used to store the data collected by the device and the data structure processed by the processor, and use the network to store the data in the cooperative database. The processor is used to process the collected data, calculate the corresponding feature summary, and finally write it to the storage device. The blockchain interface is used to upload the calculated feature summary and asset structured description information to the blockchain.

4.3. Digital Deposit of Asset Flow

The main features of blockchain are decentralization, tamper proof, programmability and traceability, which can be well applied to applications based on open scenarios. Under the guidance of the idea of decentralization, all nodes in

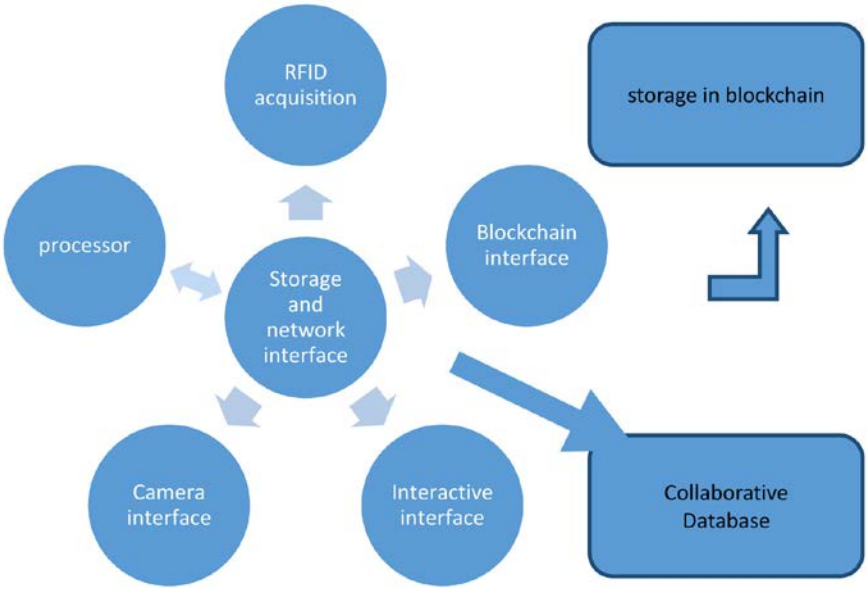

Figure 3. Structure of asset information collection equipment.

the blockchain reach consensus on the stored blocks through the consensus mechanism to ensure that the data in the blockchain cannot be tampered with. This paper uses the chain storage structure of the blockchain to ensure that it is tamper proof, traceable and non repudiation, and uses the collaborative mechanism of the blockchain to store data on the blockchain, while the collaborative database also stores corresponding data backups to meet the needs of digital verification.

As shown in Figure 4, first obtain the physical asset ID, which is used to uniquely identify the corresponding asset. Then, the specific details of asset information changes are described and signed by the operator. Then calculate the characteristic summary for the obtained asset records. Then, the feature summary and the information recorded in the previous step are stored in the collaborative database. Finally, the summary information in the feature summary and the above data records is stored in the blockchain to ensure the consistency between the data stored in the blockchain and the data stored in the collaborative database.

The last two steps are atomic operations, which need to be executed or not executed at the same time to ensure the consistency of the data stored in the blockchain and the data stored in the collaborative database.

In step 1, if the physical asset contains RFID tags, an auxiliary device can be used to directly read RFID as the physical asset ID; for assets lacking RFID, you can manually enter the physical ID of the asset.

The structured description information of the physical objects included in Step 2 mainly includes the value of the physical assets, installation location, service life, and the acceptance signature of each department. Different fields will be provided to standardize the operations in different phases. For example, the equipment acceptance department pays attention to whether the equipment indicators are up to standard, and the financial department pays attention to whether the equipment procurement is in line with the expenditure budget. At

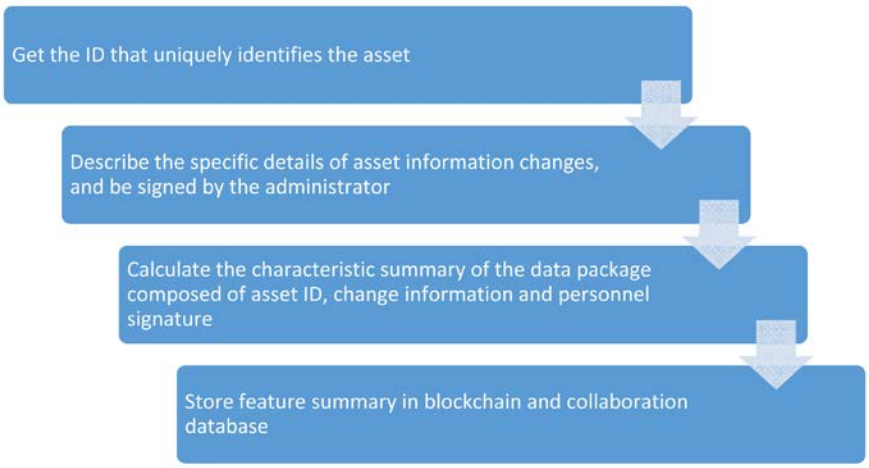

Figure 4. Flow chart of digital asset deposition.

the same time, it can provide unstructured description information to explain assets.

The feature digest used in step 3 is an irreversible compression mapping algorithm. The available algorithms include MD5, SHA-1, SHA-256, SHA-512 and RSA encryption algorithms.

Finally, the structured description information and unstructured information are stored in the collaborative database. The feature summary and summary information are stored in the blockchain, which can not only ensure the verifiability of stored data, but also reduce the storage pressure of devices in the blockchain.

5. Digital Verification of Asset Flows

Digital verification is required for any asset used. Only the verified assets are considered as legal assets. The verification process is shown in Figure 5.

In step1, Obtain the physical grid ID used to uniquely identify the asset. In step 2, the database needs to be queried through the network, and the device needs to work with the network link, otherwise the query cannot be performed. At the same time, because the feature summary is a mapping relationship, different grid asset fields will produce different feature summaries. If the grid asset fields change, the feature summary will certainly change, and the blockchain cannot be successfully verified.

6. Experiment Result

The traditional asset management is mainly to manage the asset information through the database. As long as the system administrator has the database operation authority, he can modify the asset data arbitrarily. In this experiment, we use the blockchain to uplink management. As blockchain has tamper proof feature, we can ensure the accuracy of asset information. At the same time, using its timestamp, we can perform traceability management on assets. The asset traceability result is shown in Figure 6.

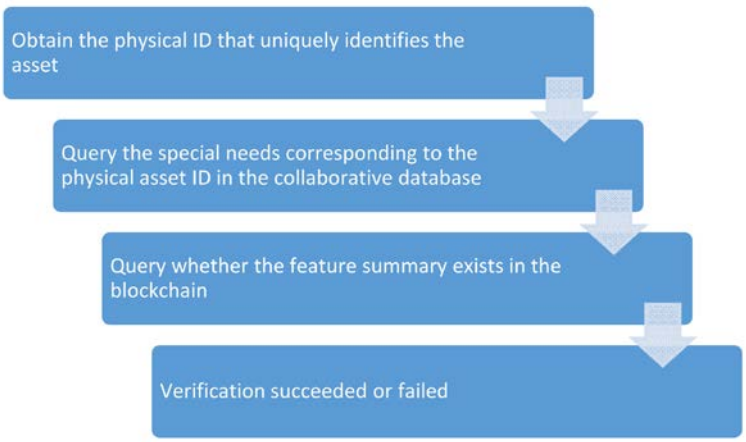

Figure 5. Asset digital verification flow chart.

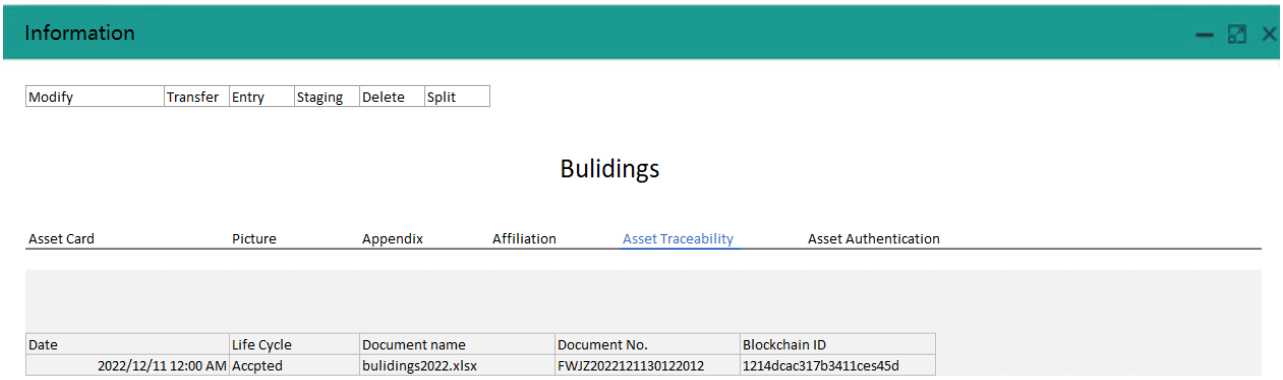

Figure 6. Asset traceablility result.

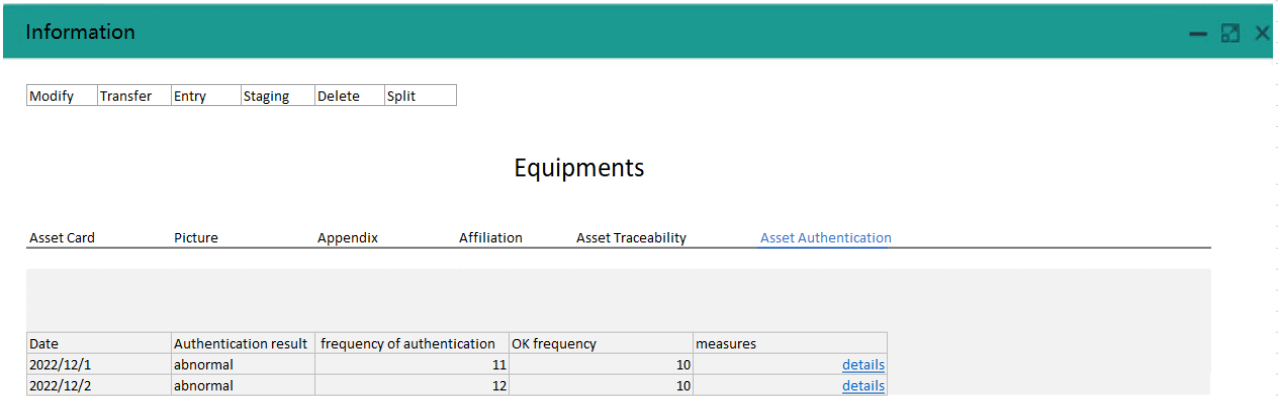

Figure 7. Asset authentication result.

Details of asset authentication

No.	Authentication result	Field Name
1	abnormal	Asset Usage Code
2	abnormal	Affiliated unit
3	normal	Purchase date
4	normal	Entry date
5	normal	Primary key
6	normal	Asset status
7	normal	Net asset value
8	normal	administrator
9	normal	Equipment classification
10	normal	User department
11	normal	Department Code
12	normal	Item No
13	normal	Asset name
14	normal	administrative department
15	normal	National standard category

Figure 8. Details of data authentication.

Asset changes involving the approval process need to be linked, including contract acceptance and posting, acceptance and transfer to fixed assets, asset collection, asset return, asset transfer, free transfer, scrap loss reporting, donation, and information correction. The modification of accounts that do not need to be approved may not be linked.

We also conducted data authentication experiments. Data authentication is mainly to regularly check the asset account information registered by the administrator and the basic asset information managed by the blockchain platform. Therefore, it is necessary to establish a verification mechanism, including verification cycle, frequency, verification content, etc. The authentication results shall be reported in time. If the key business data is changed, the system needs to give the corresponding alert prompt. The test results are shown in **Figure 7**.

Click details to view the details of authentication, including the names of exception fields and normal fields. As shown in **Figure 8**.

7. Conclusion

Through the research of this project, we not only realized the integrated supervision of the early, middle and late stages of assets, but also realized the process tracing of university assets and the authentication of key data information through the application of blockchain technology, established a highly transparent and reliable asset management mechanism, and achieved the whole process and integrated management and control objectives of asset management. The blockchain technology is used to break the barriers between various departments and achieve universal supervision and sharing. It provides strong support for comprehensively and accurately grasping the total amount, composition, distribution, increase and decrease of assets, ensuring the consistency of assets between accounts and accounts, between accounts and reality, and realizing the dynamic supervision and effective utilization of university assets. In the future, we will continue to study smart contract technology based on blockchain technology, which will bring new opportunities to asset management.

Fund Project

This work was supported by 2021 Beijing Education and Science 14th "Five-Year" Planning Project under Grant AGDB21194.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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